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DESIGN OF MULTIPLE MICROCONTROLLERS PLATFORM FOR USE IN ACADEMIC ENVIRONMENT

RAJA SARAVANA KUMAR A/L SELVAKUMAR

Thesis submitted in fulfilment of the requirements
For the award of the degree of
Master of Engineering in Electronics

Faculty of Electrical & Electronics Engineering
UNIVERSITI MALAYSIA PAHANG

JULY 2012

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LIST OF SYMBOLS

R_X	Resistor
C_X	Capacitor
S_X	Switch
SW_X	Push Button, Selector Switch
D_X	Diode
J_X	Connector Jack
Y_X	Crystal
U_X	Integrated Circuit, Chip
P_X	Data Connecter
Q_X	Transistor
JP_X	Jumper Connector
MG_X	Motor
a	Angle per step
s	Number of steps per rotation
θ	Prescaler Phase
$Fosc$	Oscillator Frequency, Crystal Value
β	Desired Baud rate
C	Clock Mode

LIST OF ABBREVIATIONS

MicroEVAT	Multi-microcontroller Evaluation Tool
CPU	Central Processing Unit
CCU	Central Controlling Unit
MCS	Microcontroller systems
I/O	Input and Output
ALU	Arithmetic Logic Unit
LCD	Liquid Crystal Display
GLCD	Graphic LCD
DC	Direct Current
DIP	Dual-In-Line Package
ROM	Read Only Memory
RAM	Random Access Memory
IR	Instruction Register
SP	Stack Pointer
EEPROM	Electrically Erasable Programmable Read Only Memory
RxD	Receiving Signal
TxD	Transmitting Signal
GND	Ground

BCD	Binary Coded Decimal
DA	Data Available
CE	Chip Enable
ADC	Analog to Digital Converter
EPROM	Erasable Programmable Read Only Memory
ASCII	American Standard Code for Information Interchange
CR	Carriage Return
LF	Linefeed
GUI	Graphic User Interface
IDE	Integrated Development Environment
VS	Visual Studio
LED	Light Emitted Diode
FMEA	Failure-Mode Effect Analysis
WP11	Windows Programming for HC11
SREC	Motorola S-Record Binary File
I8HEX	Intel 8-bit Binary File
PC	Program Counter
USB	Universal Serial Bus
X-CTU	XBEE Configuration Tool Unit
UART	Universal Asynchronous Receiver Transmitter
USART	Universal Synchronous Asynchronous Receiver Transmitter

ABSTRACT

Embedded systems have an everyday presence and direct impact in every day's lives. Therefore, learning institutions are continuously improving their courses in microcontroller and embedded system programming. Although the diversity of curriculums, the availability of learning tools, where the student can practice and improve their skills, is a key factor to the success of the learning process. The platform developed and presented in this thesis results from author's experience in teaching and learning embedded systems. From the analysis of teaching and learning needs, a learning environment based on the Freescale HC11, MCS51, and Microchip PIC 18 Series families was designed, which led to the Multiple Microcontrollers Evaluation Tool (MicroEVAT). This tool can be expanded by modules and adjusted at a specific time to student's real needs. All modules can be interconnected by an IDE bus, allowing expanding the capabilities of the platform. Series of test-run are conducted to verify MicroEVAT system performance. The developed modules allow the practice of subjects related with digital Input and Output interface, analogue interface, user interface, wireless communications, and energy management and conservation. The hardware, software and system architecture used to develop the MicroEVAT are described in detailed in this thesis. In this respect, the MicroEVAT were applicable for education and expose the electrical engineering students to the understanding of microcontroller in electronic design field and embedded systems. The work done for this research project gives solid bases and chances for fast evolution in embedded control technology research.

ABSTRAK

Sistem kawalan terbenam mempunyai peranan khas dan kesan langsung didalam kehidupan seharian. Oleh itu, institusi pengajian sentiasa memperbaiki kursus-kursus yang berkaitan dengan mikropengawal dan pengaturcaraan sistem terbenam dari masa ke semasa. Dengan kepelbagaian kurikulum dan alat pembelajaran, dimana pelajar boleh berlatih dan meningkatkan kemahiran mereka, merupakan faktor utama kepada kejayaan proses pembelajaran mereka. Platform yang dibangunkan dan dibentangkan di dalam tesis ini adalah hasil daripada pengalaman penulis dalam pengajaran dan pembelajaran sistem kawalan terbenam. Daripada analisis keperluan pengajaran dan pembelajaran, persekitaran pembelajaran yang berdasarkan mikropengawal Freescale HC11, MCS51, dan Mikrochip siri keluarga PIC 18 telah direka (MicroEVAT). Alat ini dapat dikembangkan dengan modul dan diselaraskan pada masa ke semasa mengikut keperluan pelajar. Semua modul boleh disaling dengan bas IDE untuk mempertingkatkan keupayaan platform ini. Beberapa siri ujian telah dijalankan untuk mengesahkan prestasi sistem MicroEVAT. Modul-modul yang dibangunkan, membenarkan dalam penggunaan dalam subjek yang berkaitan dengan digit, analog, komunikasi tanpa wayar, pengurusan dan pemuliharaan tenaga. Seni bina perkakasan, perisian dan sistem yang digunakan untuk membangunkan MicroEVAT telah dinyatakan dengan terperincinya didalam tesis ini. Dalam hal ini, MicroEVAT dapat diamalkan melalui pendidikan dan mendedahkan pelajar kejuruteraan elektrik kepada pemahaman mikropengawal dalam bidang reka bentuk elektronik dan sistem terbenam. Kerja yang dilakukan untuk projek penyelidikan ini telah memberikan asas yang kukuh dan peluang untuk evolusi yang cepat didalam penyelidikan teknologi kawalan terbenam.

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